

**Citation:**

Ovaskainen ML, Reinivuo H, Tapanainen H, Hannila ML, Korhonen T, Pakkala H. Snacks as an element of energy intake and food consumption. *Eur J Clin Nutr.* 2006; 60: 494-501.

**PubMed ID:** [16319836](#)

**Study Design:**

Cross-sectional design

**Class:**

D - [Click here](#) for explanation of classification scheme.

**Research Design and Implementation Rating:**

POSITIVE: See Research Design and Implementation Criteria Checklist below.

**Research Purpose:**

- Examine the role of snacks in the Finnish diet
- Identify which foods are snacks
- Establish the energy contribution of snacks to adults' diets
- Describe the social background of individuals with a snack-dominating meal pattern.

**Inclusion Criteria:**

- Age 25 to 64 years
- Participation in the FINRISK 2002 population survey and selection into a random subsample for further study
- Provision of acceptable data in the FINDIET 2002 48-hour dietary recall interview
- Human subjects review and consent processes were not described.

**Exclusion Criteria:**

- Age less than 25 or more than 64 years
- Non-selection or participation in FINRISK 2002 and the random subsample
- Provision of unacceptable data in the FINDIET 2002 48-hour dietary recall interview.

**Description of Study Protocol:****Recruitment**

- Subjects were a random subsample from the FINRISK 2002 population survey
- FINRISK 2002 was an age-, sex-, and region-stratified random sample drawn from the population registers of six regions in Finland
- The random subsample used for the present study were drawn from five regions.

**Design**

The cross-sectional design consisted of completing a 48-hour dietary recall and several health and sociodemographic questionnaires.

**Dietary Intake/Dietary Assessment Methodology**

- Automated, multipass 48-hour dietary recalls with trained interviewers

- Food models, packages, utensils and photos aided portion size estimation
- Items were converted to nutrients using the Finnish food composition database.

## Statistical Analysis

- All analyses were conducted separately for men and women
- Foods were categorized into 17 groups to describe the proportion of subjects consuming from each group. Food intake was described in grams (g) per day. Mean contribution of food groups to energy of snacks and meals was calculated
- ANOVAs were used to explore differences in dietary intake by gender, within-subject meal energy density and nutrient intake between meal patterns between gender groups
- Mixed linear models were used to generate day-to-day correlation coefficients for energy intake
- Logistic regression, adjusted for average daily energy intake, was used to assess the relationship between background factors and the snack-dominating meal pattern.

## Data Collection Summary:

### Timing of Measurements

- The design was cross-sectional
- It appears that the subsample was invited to complete 48-hour recalls after participating in FINRISK 2002
- All FINRISK 2002 data were collected in Spring 2002.

### Dependent Variables

- Professional status: Non-manual worker, student, manual worker, farmer; retired, unemployed, housewife
- BMI (kg/m<sup>2</sup>):
  - Less than 25, normal weight
  - 25 to 30, overweight
  - More than 30, obese
- Eating event: Breakfast, lunch, dinner, drink, evening snack, other snack, other eating event
  - Eating events were further classified as main meals (breakfast, lunch, dinner) and snacks
  - Eating events were identified by participants, based on the time, name, or other description. Interviewers would clarify any ambiguity with subjects before completing the interview
- Total daily energy intake (kJ)
- Energy from foods (kJ)
- Energy density of foods and energy-containing beverages (kJ per 100g)
- Energy density of foods and all beverages (kJ per 100g)
- Nutrients
  - Fat, protein, carbohydrate, alcohol, fiber, sugars, sucrose (all as g and g per MJ)
  - Vitamin C, vitamin E, calcium, potassium, sodium, iron, magnesium (all as mg and mg per MJ)
  - Vitamin A, vitamin D (both as µg and µg per MJ).

### Independent Variables

- Gender
- Meal pattern (snack dominating vs. not): A snack-dominating pattern was defined by first computing the mean energy contribution (kJ) of main meals and snacks. If snacks' energy contribution was greater than that from meals, then subjects were classified into the snack-dominating pattern.
- Age: 25 to 34, 35 to 64 years
- Region: Southern vs. Northern Finland
- Professional status: Non-manual worker, student, manual worker, farmer; retired, unemployed, housewife.

### Control Variables

- Age: 25 to 34, 35 to 64 years
- Region: Southern vs. Northern Finland
- Average daily energy intake

Variables may be listed in more than one category depending on their function in different analyses.

## Description of Actual Data Sample:

- *Initial N*: 3,181
- *Attrition (final N)*: 2,007 (912 males, 1,095 females)
  - Of the 3,181 in the random subsample from FINRISK 2002 that were invited, 64% participated and 98% of those provided valid recall data
  - The participation rate was therefore 63%
- *Age*:
  - Males: 21% were 25 to 34 years
  - Females: 24% were 25 to 34 years
- *Other relevant demographics*:
  - 74% to 76% employed
  - 23% to 25% retired, unemployed or housewife
- *Anthropometrics*:
  - 31% of males and 48% of females were normal weight
  - 47% of males and 32% of females were overweight
  - 22% of males and 19% of females were obese
- *Location*: Five regions in Finland.

## Summary of Results:

- The mean number of daily eating events was 6.0 for men and 6.1 for women. The mean number of daily snacks was 3.7 for men and 3.8 for women
  - Breakfast was the most commonly eaten meal. 93% of males and 97% of females had breakfast on at least one of the two recall days
  - Snack consumption was also common. 84% of males reported at least one evening snack and 91% reported another snack. The proportions for females were 89% and 97%, respectively
- 50% or more of adults consumed from the following food groups for snacks: Coffee or tea, milk products, bread, water, sweets, meat or fish, fats, sweet bakery goods and fruit or fresh vegetables
  - Men: Most energy from snacks came from sweet bakery goods (14%), breads (14%), alcoholic beverages (13%) and milk products (12%) for men
  - Women: The main contributors were sweet bakery goods (18%), bread (14%), milk products (12%) and sweets and chocolate (19%)
- In repeated measures, ANOVA models controlling for age and region, meals provided more daily energy, but snacks were more energy dense than meals:

	Men (N=912)		Women (N=1,095)	
	Snacks (Mean, SE)	Main Meals (Mean, SE)	Snacks (Mean, SE)	Main Meals (Mean, SE)
<b>Total energy intake (kJ)</b>	3,305 (68)	5,854 (74)	2,632 (45)	3,987 (46)
<b>Energy density of foods and energy-containing beverages (kJ per 100g)</b>	532 (9)	483 (4)	522 (8)	436 (3)
<b>Energy density of foods and all beverages (kJ per 100g)</b>	231 (3)	359 (3)	203 (3)	293 (3)

$P < 0.0001$  for all snack and meal comparisons for both genders.

- 19% of males and 24% of females had a snack-dominating meal pattern (more daily energy from snacks than meals).
- When controlling for age and region, several differences in nutrient intakes between meal-dominating and snack-dominating patterns were observed among both men and women (see following table).
  - When adjusting for average daily energy intake, the snack-dominating pattern was 1.6 times as likely in Southern than Northern Finland.
  - Among men, the pattern was 1.5 times as likely among manual workers and farmers than it was among non-manual workers and students. Among women, the pattern was 1.4 times as likely among younger than older individuals

(P<0.05 for all comparisons).

	Men		Women	
	Main Meal-dominating Diet (Mean, SE)	Snack-dominating Diet (Mean, SE)	Main meal-dominating Diet (Mean, SE)	Snack-dominating Diet (Mean, SE)
<b>N</b>	741	171	829	266
<b>Energy (MJ)</b>	9.02 (0.10)	9.77 (0.25)**	6.56 (0.07)	6.80 (0.14)
<b>Energy of foods (MJ)</b>	8.89 (0.09)	9.02 (0.21)-	6.48 (0.07)	6.64 (0.14)-
<b>Fat (g)</b>	86.8 (1.3)	88.8 (2.9)	58.4 (0.8)	60.1 (1.7)
<b>Fat (g per MJ)</b>	9.50 (0.07)	9.08 (0.19)*	8.78 (0.07)	8.71 (0.13)
<b>Protein (g)</b>	87.2 (1.1)	83.1 (2.1)	64.2 (0.7)	60.4 (1.3)**
<b>Protein (g per MJ)</b>	9.77 (0.07)	8.76 (0.17)**	9.93 (0.07)	9.07 (0.14)**
<b>Carbohydrate (g)</b>	237.0 (2.9)	251.4 (6.7)*	186.6 (2.1)	196.3 (4.2)*
<b>Carbohydrate (g per MJ)</b>	26.5 (0.2)	26.2 (0.4)	28.5 (0.2)	29.1 (0.3)*
<b>Alcohol (g)</b>	8.3 (0.7)	25.9 (4.2)**	3.0 (0.3)	5.2 (0.8)**
<b>Alcohol (g per MJ)</b>	0.87 (0.06)	2.24 (0.30)**	0.43 (0.04)	0.72 (0.1)**
<b>Vitamin C (mg)</b>	95.3 (2.9)	74.3 (5.0)**	107.1 (2.5)	99.6 (4.0)
<b>Vitamin C (mg per MJ)</b>	11.0 (0.3)	8.4 (0.6)**	17.2 (0.4)	16.1 (0.7)
<b>Vitamin A (µg)</b>	1,082 (61)	854 (50)	948 (41)	858 (56)
<b>Vitamin A (µg per MJ)</b>	122 (6)	92 (6)*	151 (7)	125 (7)-
<b>Vitamin E (mg)</b>	11.94 (0.21)	11.26 (0.39)	9.06 (0.16)	8.52 (0.23)-
<b>Vitamin E (mg per MJ)</b>	1.34 (0.02)	1.18 (0.04)**	1.39 (0.02)	1.27 (0.03)**
<b>Vitamin D (µg)</b>	5.84 (0.23)	5.49 (0.43)	3.90 (0.15)	3.29 (0.19)
<b>Vitamin D (µg per MJ)</b>	0.65 (0.02)	0.61 (0.06)	0.61 (0.02)	0.50 (0.03)
<b>Fiber (g)</b>	22.15 (0.38)	20.12 (0.81)	18.74 (0.28)	17.72 (0.48)
<b>Fiber (g per MJ)</b>	2.52 (0.04)	2.17 (0.09)**	2.94 (0.04)	2.71 (0.07)
<b>Sugars (g)</b>	101.8 (1.8)	123.6 (4.8)**	85.8 (1.3)	98.7 (2.7)**
<b>Sugars (g per MJ)</b>	11.3 (0.1)	12.7 (0.4)**	13.0 (0.1)	14.6 (0.3)**
<b>Sucrose (g)</b>	47.3 (1.1)	58.0 (3.1)**	40.8 (0.8)	49.8 (1.9)**
<b>Sucrose (g per MJ)</b>	5.18 (0.10)	6.01 (0.31)**	6.07 (0.10)	7.13 (0.19)**

<b>Calcium (mg)</b>	1,196 (22)	1,148 (41)	966 (14)	986 (27)
<b>Calcium (mg per MJ)</b>	133 (2)	121 (4)**	150 (2)	147 (3)
<b>Potassium (mg)</b>	4,044 (44)	3,794 (87)*	3,225 (32)	3,059 (52)*
<b>Potassium (mg per MJ)</b>	462 (4)	404 (8)**	508 (4)	473 (8)**
<b>Sodium (mg)</b>	3,992 (52)	3,636 (92)*	2,764 (32)	2,544 (53)**
<b>Sodium (mg per MJ)</b>	448 (4)	385 (9)**	429 (4)	383 (6)**
<b>Iron (mg)</b>	13.4 (0.2)	12.4 (0.4)	10.1 (0.1)	9.7 (0.2)
<b>Iron (mg per MJ)</b>	1.51 (0.02)	1.33 (0.04)**	1.57 (0.02)	1.45 (0.02)**
<b>Magnesium (mg)</b>	403.6 (4.6)	408.3 (11.2)	310.9 (3.2)	304.5 (5.3)
<b>Magnesium (mg per MJ)</b>	45.9 (0.4)	43.0 (0.8)**	48.7 (0.4)	46.7 (0.7)

P-value of 0.05-0.1; \* P-value of 0.01 to 0.05; \*\* P-value <0.01.

#### Author Conclusion:

- Meals were a greater contributor of energy than snacks, although snacks were more energy dense. Compared to previous reports, it appears that energy from snacks is increasing
- One-fifth of men and a quarter of women had more energy from snacks than meals. A snack-dominating eating pattern is associated with lower micronutrient intakes and is incompatible with nutrition recommendations
- Snacks and meals were identified by subjects in this study. Other methods have been used (e.g., types of items, times consumed, etc.). These methodological differences make direct comparisons challenging.

#### Reviewer Comments:

##### *Author-identified limitations:*

- *Subjects may have under-reported their intake, and other research has shown that snacks are more likely to be under-reported than meals, particularly among frequent snackers*
- *Seasonal variations in intake could not be captured in this study*
- *A relatively low participation rate may have biased the findings or limited generalizability.*

##### *Additional issues with the study:*

- *Sources of funding were not disclosed. Although it is unlikely that a conflict of interest may exist, it is impossible to conclude definitively*
- *In the methods section, it sounds as though subjects completed a single 48-hour recall. In the discussion section, the authors reference two 24-hour recalls. Recalls over longer periods are subject to greater memory decay, so it is unclear whether the dietary assessment method can truly be considered valid and reliable*
- *Fridays were not represented in the dietary recalls. Since Friday is typically the start of the weekend, people's eating patterns on this day may be different from other weekdays and possibly even weekend days too. Thus, the dietary data may not accurately capture individuals' typical diets*
- *Since the sample was drawn randomly from a larger stratified sample, it is unclear whether the authors appropriately adjusted variance estimation to account for the departure from simple random sampling. Without accounting for stratified selection, point estimates and statistical conclusions may be incorrect*
- *There were 68 nutrient comparisons made. With so many statistical tests, a significance threshold of 0.05 to 0.1 is not stringent enough to minimize type one errors; a Bonferroni correction may have been more appropriate when determining a significance level.*

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

  

Validity Questions		
1.	<b>Was the research question clearly stated?</b>	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	<b>Was the selection of study subjects/patients free from bias?</b>	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	<b>Were study groups comparable?</b>	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	Yes
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	<b>Was method of handling withdrawals described?</b>	Yes
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes

4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	<b>Was blinding used to prevent introduction of bias?</b>	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	<b>Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were intervening factors described?</b>	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	<b>Were outcomes clearly defined and the measurements valid and reliable?</b>	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	N/A
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	N/A
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	<b>Was the statistical analysis appropriate for the study design and type of outcome indicators?</b>	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes

8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
<b>9.</b>	<b>Are conclusions supported by results with biases and limitations taken into consideration?</b>	<b>Yes</b>
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
<b>10.</b>	<b>Is bias due to study's funding or sponsorship unlikely?</b>	<b>Yes</b>
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes